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ABSTRACT

This paper discusses Australia's two packet-switching networks, AUSTPAC and MIDAS, which are used for data transmissions with other computers located within Australia or between overseas destinations. Although the facilities of both are similar, a comparison of their services based on traffic volume, connection, registration, and rental charges is made for the benefit of those unacquainted with technical and communication terms. AUSTPAC is the major focus of this paper, which discusses Deakin University's preference for AUSTPAC to provide low-cost database searches for students, and suggestions for the management functions for its implementation; an AUSTPAC link-up between Deakin and the Open University (OU) in the United Kingdom for teaching master courses, use of electronic mail, and other administrative functions, use of videotex systems for general information dissemination, and the design of and access to computerized research and bibliographical databases; the AUSTPAC billing software and plans for future computer facilities for staff and student access; general procedures for accessing AUSTPAC; an explanation of basic concepts and technical aspects of AUSTPAC's Packet Assembler/Disassembly (PAD) facility for packet-switching; variables for successful usage of AUSTPAC; problems encountered in the 1985 AUSTPAC trials; computer-mediated communications and educational use; and staff and student development in the use of computer technology. Several tables are provided for illustrative purposes. (DJR)

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Computer Communications Working Group Report no.1

THE USE OF AUSTPAC AT DEAKIN UNIVERSITY FOR DISTANCE EDUCATION

Angela Castro and Lee Stirzaker
20 January 1986

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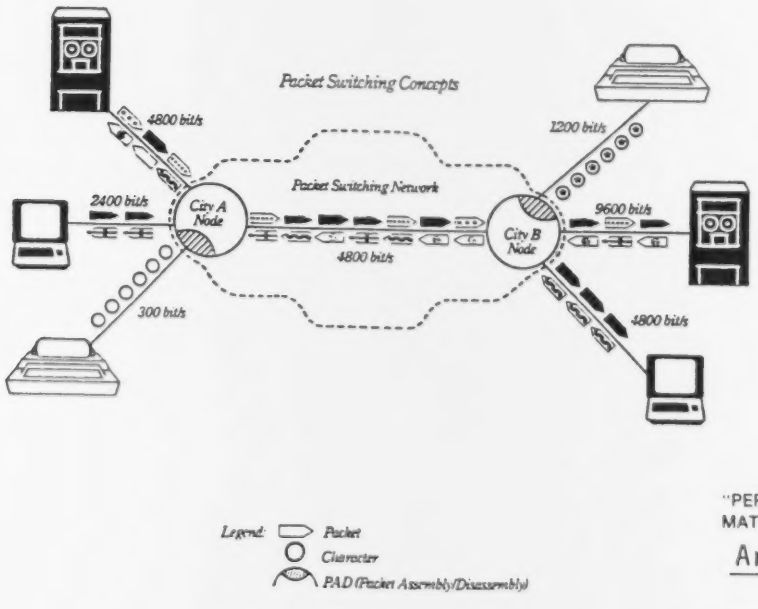
What are Austpac and Midas?

Two computers can communicate with each other if they are connected by a cable or telephone. But the cost of a telephone connection can be quite high if the distance and connect time involved are long. One way of reducing the cost is to use a packet-switching network service, which treats all datel calls as local calls and charges a standard rate for connect time and volume of data transmitted irrespective of the distance involved. The charges are kept low by the fact that there is no need to maintain a dedicated circuit between the two computers. All data are organised into packets of discrete quantities and conveyed through a network over logical links called 'virtual circuits'. Figure 1 below shows how computers using different speeds for data transmission are linked up to a packet-switching network which 'queues' the data packets from different sources for transmission. The terms in the legend are important and will be explained later in this paper.

Figure 1



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TO THE EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)."

Austpac and Midas are two such public networks used for data transmission within Australia and between Australian and overseas destinations.

In a way they are rival services offered by two different semi-government organisations. Austpac is a service Telecom Australia launched in December 1982; Midas is offered by the Overseas Telecommunications Commission (OTC). The emphasis of Midas has always been on international data transmission while Austpac is used more for data transmission within Australia and is the legal national carrier. In fact, one is not permitted to use Midas within Australia, one of the few exceptions allowed being the access of Minerva, a new electronic messaging service introduced by the OTC in June 1984, which can be accessed either via Austpac or Midas. When an Austpac customer wants to access a remote overseas site, that is done for him via the Midas gateway without his being aware of it, and that part of the billing is done by the OTC for Telecom. So there is also collaboration between the two services and organisations.

The facilities of both services are very similar, but Austpac appears to be more competitive in its charges.

Austpac and Midas charges

The costs of both services depend very much on whether a terminal used for data transmission is linked to the services through dedicated line access or through the Public Telephone Switched Network (PSTN), and whether the connection is made nationally or internationally.

The two services distribute leaflets about its charges but they can be a bit confusing to people who are unacquainted with technical, communications terms. We hope to provide, in this paper, some clearer information about the main categories of charges of concern to the ordinary users by explaining what some of those terms mean.

The three main categories of charges are as follows.

1 Volume of traffic

Basically, traffic volume is what a user types in, sends or receives and is expressed in terms of kilosegment. Each segment contains up to, and therefore represents, 64 characters (to the lay person), or 64 octets (to the communications expert), or 512 bits (to a computer programmer).

For traffic within Australia, Austpac charges $1 per kilosegment with after-hour discount of 50 per cent. Midas charges $11 per kilosegment; there is no discount.

For overseas traffic, both Austpac and Midas charge $11 per kilosegment. However, if the user's terminal has dedicated line access (which costs more in initial installation and incurs other fees), the traffic volume

for both Austpac and Midas users charged is the total monthly volume. A variable charge as follows is also applicable:

$11 per kilosegment for the first 50 kilosegments;
$ 9 per kilosegment for the next 100 kilosegments;
$ 7 for all in excess of 150 kilosegment.

One of Deakin's three central computers, a DEC-20 machine called Bravo, has dedicated line access to Austpac but, so far, none of the Austpac users has transmitted enough data monthly for him or her to enjoy the cheaper charge.

2 Connection charges

For national transmission, Austpac charges terminal users with dedicated line access 33 cents per hour, and those with PSTN access $4 per hour. After-hour discount of 90 per cent is allowed only to terminal users with dedicated line access. Midas charges $22 per hour; again, there is no discount allowed for after-hour connection.

For overseas connection, Austpac charges $10.80 per connect hour while Midas charges $22 per connect hour. For terminals with dedicated line access, however, both charge only $7.80 per hour.

The telephone call to any one of the three Austpac telephone numbers catering for different data transmission speeds is 16 cents, irrespective of where the call is from and where the eventual connection is to be, in Australia or overseas. The call to Midas in Sydney is toll-free, and this fact is often quoted by OTC sales representatives in promoting Midas over Austpac.

3 Registration and rental charges

Austpac charges $50 as a once-only registration fee and a monthly rental of $4 for an NUI holder (NUI stands for Network User Identifier, which can be thought of as a password for using the service), but quite a lot more for an organisation with dedicated line access which runs into thousands of dollars. Midas does not levy any registration or rental charges but probably charges a comparable rate for dedicated line access.

For Austpac and Midas users who opt for NUI access, they will have to type that in every time they get connected to the services. Needless to say, the NUI has to be kept confidential because that is how usage is monitored and charged. The Austpac NUI is a 12-character alphanumeric sequence; the Midas NUI is a 6-character one.

To give an idea of the sort of expenses one has to meet when using Austpac for data transmission, we have reproduced some billing figures for two Austpac users at Deakin in Figure 2.

L is a lecturer at Deakin who called an overseas computer from the Deakin central computer Bravo which has dedicated line access to Austpac and which uses a modem speed of 2400/2400 bps (that is, receiving data at 240 characters per second, and sending data at 240 characters per second). S is a computing student who connected his home microcomputer in Gippsland - which is 400 kilometres away from Deakin - to Bravo by dialling an Austpac number and using an acoustic coupler of 300/300 bps (that is, receiving and sending data at 30 characters per second).

Figure 2

	L		S	
Conn. hrs. & charge	0.52	$ 4.06	1.58	$ 6.32
Kilosegments & charge	2.09	$22.99	2.78	$ 1.39
Conn. charge		$ 0.16		$ 0.16
Total charge		$27.21		$ 7.87

So L was charged 16 cents for his telephone call from Bravo to Austpac which then connected him to an overseas computer for just over half an hour, during which time he sent and received 2.09 kilosegment of data. S also had to pay 16 cents for the Austpac call which then connected his home microcomputer to Bravo for just over one and half hours, during which he sent and received 2.78 kilosegments of data. But the charges for connect time and traffic volume were quite different for the two users (see Figure 3) because L's connection was to an overseas machine and S's was to a national machine.

Figure 3

	L	S
Charge per hour	$ 7.80	$ 4.00
Charge per kilosegment	$11.00	$ 0.50

Note that S enjoyed an after-hour discount of 50 per cent for data transmitted nationally. Normally it is $1.00 per kilosegment.

Some people will probably wonder why the data transmitted and connect time did not tally for the two users. The answer is that there is no direct relationship between the volume of data transmitted and the connect time. The volume of data transmitted depends directly on the transmission speed and circumstances. First, the speeds used by the two people were different; L used 2400/2400 and B used 300/300 bps. Then User L could have typed at a good speed or used the 0.52

hour for sending or receiving files. User S could have been spending most of his 1.58 hours sitting in front of his microcomputer and thinking about a program with very little data transmission in either direction. Transmission rate for both was also affected by the traffic condition of the entire Austpac network. All these variables will be covered later in this paper.

Deakin's Graduate Diploma of Computing and Austpac

Deakin prefers Austpac for pragmatic cost considerations. The Deakin University Library used Midas in the past for overseas automated database searches but has now changed to Austpac.

The Computer Centre registered with Austpac at the beginning of 1985 to enable Deakin's off-campus Graduate Diploma of Computing students to telephone Bravo, one of its central computers, and have all charges reversed at the time of call. Bravo has a Datel Dedicated Line to Austpac and an X.25 network address (more about this later) , so BRAVO can receive incoming calls 24 hours a day. Most marked assignment and notices are left in the students' directories on Bravo for their collection when they dial in via Austpac.

The chief aim of implementing Austpac on Bravo was to reduce the telephone costs for students living outside Geelong.

In the past, students had simply linked up their home microcomputer to Bravo through a normal STD call. This had proved to be quite expensive for those remote students who had to spend a long time doing all sorts of activities while they were connected to Bravo, e.g. running programs, transferring data, submitting assigments. Access to Bravo using an STD call also means being restricted to a 300/300 line speed which is the speed of the ten Deakin modems used for STD dial-in to Bravo. This speed is rather slow and can affect the connect time and push up consequently the charges even further. Eventually a group of students were asked by a senior lecturer to experiment with Austpac to see if it would reduce the telecommunication costs, and the finding was that it did. Now remote students can elect to use Austpac if they so wish. As a result, we have interstate students taking advantage of this cost-saving measure, but we also have students living quite close to Geelong who want to use it as well. Deakin, as a matter of policy, does not lend modems or acoustic couplers to students, but the School of Sciences have a reasonable number of accoustic couplers for hire.

But the implementation of Austpac also necessitates some management functions on the part of the lecturers teaching the course and the Computer Centre which looks after the billing. The computing lecturers have to check daily the messages and assignments from the students, process them, and keep some records, while lecturers of other courses in Deakin who do not use such means of communication with their students have the service of the Operations Unit in the

Registrar's Division to check in and return hardcopy assigments, and keep records of assessments. There is, as yet, no overall institutional policy for centrally servicing academic schools and staff who want to use computer-mediated communications for course maintenance.

As for the Computer Centre, at the beginning of each semester, it sends out a form to each computing student who wishes to use Austpac access to Bravo. The student fills out the form, and forwards an advanced payment of A$200 for his anticipated usage of Austpac. The student's account name and details are then entered into an administrative control file used by the Austpac security and billing software on Bravo. After each access session, the Deakin PAD (a very important device for packet-switching bought from Datacraft for about $10,000) summarises the X.25 usage for the session which is then collected by the billing software. Based on this data, a monthly billing run is performed and the usage-and-charges report is then sent to the University's Finance Branch. At the end of each semenster, after the student has finished using Austpac, the balance of the $200 is refunded to him.

The Austpac usage of Deakin students varies widely. However, the Computer Centre has found that no student has spent more than $60 or less than $1 per month, with the average usage being about $25 per month.

The Computer Centre has prepared some simple but clear instructions for students on the use of Austpac in its Computer users handbook, an annual publication, and DATABITS, a lively monthly newsletter for staff and students giving comments, guidance and news. It also encourages the use of a common file-transfer protocol called KERMIT which has been developed at the University of Columbia with versions prepared specially for a good range of mainframe, mini and micro computers. KERMIT is widely available to institutions at a nominal fee.

Although no formal evaluation has been undertaken on student usage of Austpac, the general response received from students has so far been positive and favourable.

The Distance Education Unit, the Open University and Austpac

In 1985, no staff outside the Computer Centre took advantage of the outdial facility to Austpac on Bravo. But in June of that year, the Distance Education Unit (DEU) approached the Computer Centre for an Austpac link-up between Deakin and the Open University (OU) in the United Kingdom.

There have been frequent consultation between some OU staff and DEU staff on the following issues:

* The teaching of master courses at a distance;

* The use of electronic mail, file transfer, and computer conferencing for course development, course maintenance, and alternative student support;

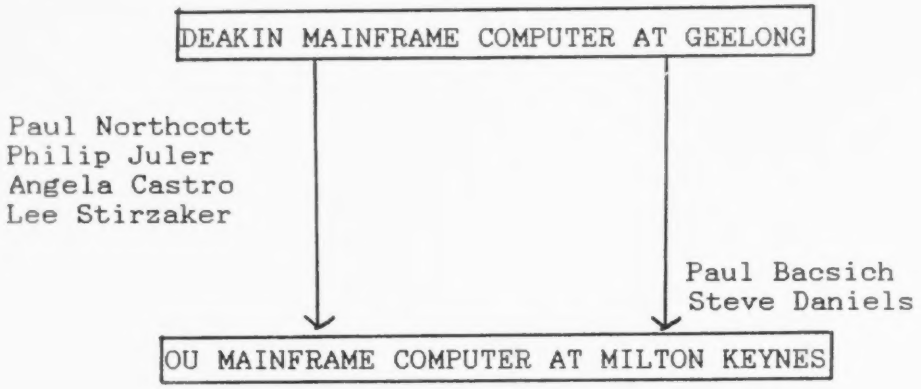
* the use of videotex systems for general information dissemination.

* The design and access of computerised research and bibliographical databases by staff and postgraduate students;

From July 1985, members from the OU and Deakin began a series of Austpac trials as the basis of a research project to be launched in mid-1986. This research project on institutional joint development of a master-level course on distance education using computer-mediated communications has now been submitted to the Standing Committee on External Studies of the Commonwealth Tertiary Education Commission for funding assistance. It is expected that about nine members from the OU and the DEU will participate. The project team members will use the new information technology for writing and discussion of course materials.

Some of the DEU and the OU staff involved in the 1985 trials have been given user privilege on each other's central computers after applying for permission from their respective computer centres. Figure 4 gives a graphic representation of the traffic direction and staff members involved in the Austpac and PSS (the British equivalent of Austpac) trials.

Figure 4



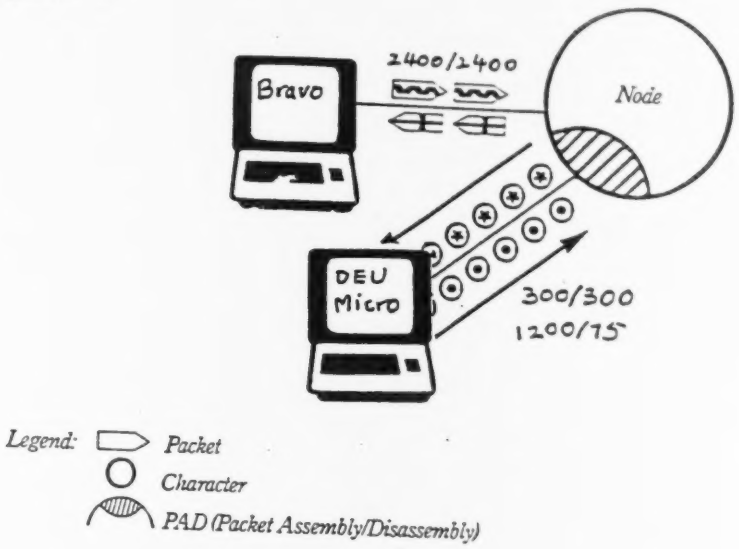
The point to note in the use of packet-switching service from central computers at institutions is that there is a built-in restriction: the DEU and the OU staff can only use the service via their institution's computers. For example, if Bravo is unavailable for any technical or other reasons on certain occasions, then there is no way that the DEU staff can be allowed into Austpac from their home or office microcomputer and then get connected to a remote correspondent directly unless they have an NUI to allow them to get to the service.

In view of this restriction and desiring more independence and flexibility in its research into communications, the DEU

took out a second Austpac account in July which uses the NUI and PSTN access.

This second Austpac account is used only for dialling out in special circumstances. The slower modems (only 300/300 and 1200/75 bps) available on DEU microcomputers, and higher charges through the PSTN access, as mentioned earlier, are factors which have persuaded the DEU to continue to rely on the Austpac facility on Bravo for bulk data transfer and to keep its communicaton channel open for the OU staff who dials in. Nevertheless, this second Austpac account and its NUI access have proved extremely useful as a backup and an alternative option whenever Bravo is unavailable, and the fixed monthly rental of $4 of that service (whether it is used or not) is not considered to be excessive. The two differnt methods of access available to the DEU to any remote correspondent (whether it is the OU mainframe, a videotex system, or a commercial database) are shown in Figure 5.

Figure 5



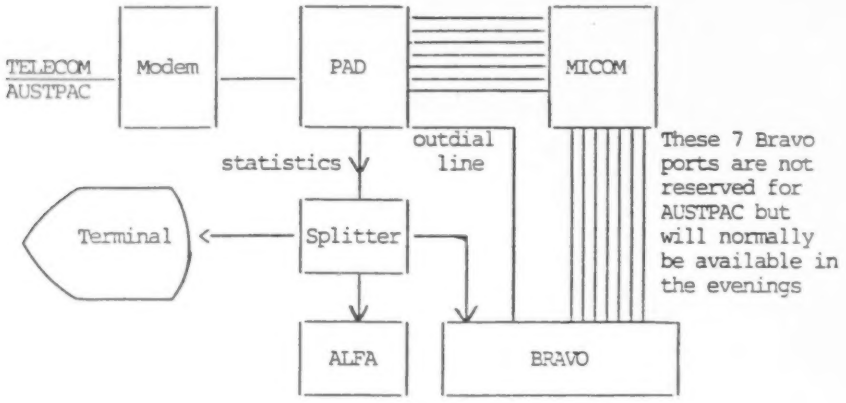
The DEU also uses KERMIT as a file transfer protocol in its dealing with the OU mainframe which also has the program and the results have been satisfactory and relatively error-free.

It is interesting to note though that one DEU member who is not as acquainted with Bravo and the KERMIT program as the others but who has come to know his microcomputer well prefers to use the PSTN and NUI access. An additional factor for his reluctance to use Bravo is because there is some problem with getting the PAD on Bravo for dialling out, a problem that the two writers of this paper will be working on in 1986.

Expansion of Austpac and other computer facilities in Deakin in 1986

Deakin has a dedicated line to the Austpac exchange at Haymarket in Melbourne with a modem that operates at 2400/2400 speed. It has eight Austpac lines at its disposal for data transmission. Five have been reserved for dialling in, one for dialling out, and so there are still two left over. The six assigned lines are all on Bravo. Figure 6 shows the present Austpac provision.

Figure 6



We think that it might be helpful for us to describe here, in some detail, the billing estimation mechanism and the access screening process included in the above figure.

The Austpac billing software runs on both Bravo and Alfa, another Deakin central computer. On Bravo, it forces out unauthorised users and monitors the connect time of legitimate and registered users. The PAD, at the end of each Austpac session, writes a statistics record containing the number of packets transmitted, the PAD line number and other information to the PAD statistics port. A splitter amplifies the signal and splits it three ways so that it is recorded on a terminal and also on Alfa and Bravo where it is read by the billing software. On Bravo, the software attempts to match each PAD statistic with a known user of an Austpac line. The software runs on Alfa partly as a backup in case Bravo has a systems crash. The billing software has been found to give a very close approximation of costs matching those in the Austpac account charged by Telecom.

Plans are underway to reassign those eight Austpac lines and share them between both Bravo and Charlie, a new central computer that uses the UNIX operating system. This will mean more flexible access for staff and students to computer facilities at Deakin; and, from the DEU's point of view, it could also create an opportunity for OU staff to come in via PSS to access DEDATA, its bibliographic database which resides on Charlie.

The DEU has made additional provision in its contacts with the OU, for example, by registering with Minerva as a user; but it still relies on Bravo as the main communication channel. It has now reached a stage of fine-tuning such contacts, examining the mail management and DEU staff development issues as well as the important aspect of costs. There are plans to extend the use of Austpac on Bravo in mid-1986 to the access of databases like ERIC and the Australian Bibliographic Database at Canberra, and and overseas videotex systems like Optel and Maris in the United Kingdom. It also hopes to access from Charlie the international ICDL distance education bibliographical database which will be built and maintained at the OU (probably on a VAX machine) a few years from now.

Other divisions and staff within Deakin have also caught on to the use of databases and the only way they can access them is via Austpac. For example, the Library, and some members of the School of Management and central administration would like to be able to access an Australian legal database called CLIRS. So it is very likely that more than one Austpac line will be required for out-dialling in 1986.

The DEU is also hoping to be able to have UNIX mail exchange with the OU in 1986 as an extra option. The OU is not yet in the UNIX mail network in the United Kingdom but is planning to join it soon.

UNIX mail as an alternative to direct use of Austpac

For some time now, DEU members, like other staff at Deakin, have been taking advantage of the ACSNET, the Australian mail network which is also known as SUN III, for mail and file delivery. They can send them out to other Australian and overseas contacts without leaving their home enviroment. Mail typed on Charlie and a growing number of minicomputers on campus is directed to a UNIX machine called Aragorn in the School of Sciences. Aragorn has an outdial modem of 1200/1200 speed to connect it to another UNIX machine called Mulga at Melbourne University which is Deakin's outside contact with ACSNET. The Aragorn modem dials Mulga every hour to dispatch and receive mail and files for Deakin.

To use the ACSNET service, Deakin only has to contribute A$1,000 a year, so it is really a very attractive option. But the most overlooked advantages of using the UNIX mail network, if we have not already made them obvious, are:

* From the user's point of view, he only has to call up the mail program on his home institution's machine, give the name and site of his correspondent, types in the messaage, give a send command, and the delivery is done for him without any further effort on his part. In other words, he does not have to know anything about Austpac and the DTE of the remote correspondent. He only has to know his own DTE well.

* From the institution's point of view, it does not have to provide access for external people who want to come in to leave mail for its staff. Most tertiary institutions are concerned about allowing external access to their central computers, which is quite understandable, because such access has technical, economic and security implications.

But for people who want to access a remote machine for mail or other purposes using Austpac, then they will have to understand the Austpac procedure and its concepts.

General procedure for accessing Austpac using an NUI

Detailed procedures for accessing the OU's computer from Bravo using a dedicated line and from the DEU's terminal equipment using PSTN and an NUI are given in a number of guides prepared by members of the Computer Communiations Working Group, an informal common interest and exploratory group with members drawn from the DEU, the OU, the Computer Centre and the Registrar's Divsion. Detailed procedure for Deakin students accessing Bravo, as mentioned earlier, is given in the Deakin University Computer Centre computer users handbook 1985, pp. 16-19 ,which should be supplemented with additional information in DATABITS.

Before describing the general procedure of accessing a remote computer via the PSTN and an NUI, we must reiterate some obvious pre-requisites for using the Austpac service:

* The user must have some data terminal equipment (DTE): e.g. a microcomputer with an accoustic coupler or modem, and some communications software.

* He must have access to a telephone and can dial out to one of three Austpac numbers depending on the speed of his acoustic coupler or modem.

* He must have an NUI which permits him to use the Austpac service after successfully dialling one of the three Austpac telephone numbers.

* He must know the X.25 address (more about this later) of the remote computer, that is, the correspondent.

* He must have user privilege on the remote machine. This means that he must be given a user code.

The procedure that follows assumes that the user has a conventional character-mode terminal (e.g. a microcomputer), an NUI and a telephone. The procedure can be applied in the access of any X.25 address, whether it be an institution's mainframe computer, a videotex system, or a commercial database.

1 Turn on the microcomputer, activate the communications software and harware.

2 Dial one of the three numbers below depending on the choice of transmission speed:

DTE line speed	Austpac tel. no.
300/300 bps	01921
1200/1200 bps	01922
1200/75 bps	01923

3 Austpac will transmit the Austpac identifier to the local DTE within five seconds if the call is successful:

AUSTPAC

4 Make a call (distance independent) request by typing in (with caps lock on, a very important step that is often overlooked) the NUI, the remote address, followed by a carriage return.

?N<NUI>-<REMOTE ADRESS> CR

This procedure is, however, different for computing students dialling in via Austpac to Bravo not using an NUI. They simply key in Deakin's national number which is as follows:

?252421000 CR

5 After the virtual call is set up, the Austpac PAD will give to the local user an acknowledgement:

COM

It will also send to the remote correspondent an appropriate signal depending on its type of terminal equipment.

6 After the remote correspondent's start-up message, you key in the user code and password to enable you to communicate with it.

7 On completion of activities, disconnect from the remote correspondent by signing off or logging out.

8 Clear the virtual call by typing in the PAD command of control-P CLR and pressing carriage return:

Control-P CLR CR

PAD will confirm that this has been done by echoing on the user's screen the following message:

CLR CONF

9 Return to the local machine by keying in the appropriate escape sequence.

10 Logout of or switch off the local machine.

The above procedure is simple enough, but often seemignly inexplicable sequences and events will happen during the careful implementation of this procedure. They are sometimes caused by an inappropriate use of C-DTE, but other times, they are the results of a poor Austpac network environment.

We think that it will be extremely helpful for a user to know something about the arcane business of computer communications if he is seriously considering their use for any worthwhile project. This is because even if an user is lucky enough to have a communications expert to consult, he might not be able to reproduce or describe coherently and lucidly what actually happened during a problematic session to enable the expert to provide an explanation and remedy.

Two of the basic concepts a user should know are: the PAD packet and the PAD user profile.

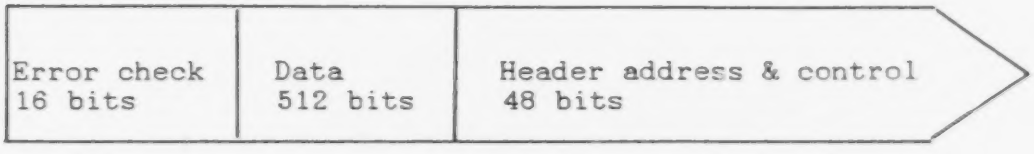
Packets

First of all, let us explain the term 'packet'. During transmission, characters sent by the DTE are collected together into a group called a packet by Austpac's PAD (Packet Assembler Disassembler). They are then disassembled at the destination to arrive as characters.

Each Austpac packet from Deakin contains 512 bits of data (or 64 characters). In addition, it contains addressing information that enables the switching nodes (there will be quite a few along the way between the caller's node and the called party's node) to send each packet to its proper destination. Furtheremore, each packet has an error-control envelope that enables automatic error detection and correction to be maintained on the links interconnecting the switching nodes. Two packets constitute a segment, which is the basic unit used for charging purpose, as mentioned in the first part of this paper.

Thus, a large file will be split up into many packets of up to 64 characters. Figure 7 is a graphic representation of the contents of a Deakin packet.

Figure 7



It would be wrong, however, for people to assume that every packet will be fully packed with 64 characters (or 512 bits). Data keyed from a DTE may only have a few characters in each packet because of the typing speed used or because of distraction or pauses during the keying process as we have pointed out earlier when we discussed Austpac costs. Obviously, the more optimal use of connect time is for the transfer of pre-composed files.

Data terminal equipent (DTE)

Some computers can control, format, transmit and receive packets, and if they interface with a packet switching data service in accordance with CCITT (The International Telegraph and Telephone Consultative Committee) Recommendation X.25, they are known as X.25 packet-mode data terminal equipment (P-DTE). They are connected to a service at very high speeds.

More often, however, our computers are the conventional asynchronous character-mode terminals which cannot control, format, transmit and receive packets. When we want to use them to communicate with another remote computer using the packet switching services, they need some help to produce the packets. To meet this need, Austpac provides the adaptation facility known as PAD (Packet Assembler/Disassembler). The asynchronous terminal must establish a call via the PAD facility in accordance with the conventions described in CCITT Recommmendation X.28; therefore these C-DTE are known as X.28 data terminals. They are connected to Auspac through one of the three categories ofspeeds: 300/300,3 1200/1200, and 1200/75.

We want to sound a word of caution here about modems. A 1200/1200 modem is not a common piece of DTE that most individuals can afford, it is currently over A$1200. Most modems used in homes are the 300/300 modems or 1200/75 modems which range in price from A$150 to A$600. The trouble is, a lot of 1200/75 modem owners think that their modems perform like 1200/1200 modems, sending and receiving data at 1200 bps. 1200/75 split-rate modems have been designed for videotex systems like Viatel and Prestel. While it is possible to use a 1200/75 modem to access a remote system that is not a videotex system, and it is faster than the 300/300 naturally for receiving files (at 1200 bps), there can be complications with using 75 bps to transmit files.

The Austpac PAD

The PAD, which is a helpful facility provided by Austpac to make packet-switching possible, can also be the most abstruse for the lay person. Before explaining why this should be so, let us be clear in our mind what the PAD actually does. It does three things:

* The setting up and clearing of virtual calls between the two DTE which are used for the communication.

* The assembly of characters received from one of the C-DTE into packets.

* The disassembly of packets received during the virtual call in order to transmit the characters which they contain to the other C-DTE.

The way the PAD operates depends on the current values of internal variables which are known as PAD parameters. There

are at least eighteen parameters in the Austpac PAD and these will be briefly described later in this report. The values can be fixed in advance or changed from session to session when the C-DTE is in a commad mode.

Throughout the time that the C-DTE is physically connected to the PAD, the C-DTE is in either the command mode or the data transfer mode.

When the terminal is in the command mode, all data characters are interpreted as service commands by the PAD. The data is not sent to the remote DTE.

The PAD parameters which define a user's profile can affect the operation of both modes.

PAD parameters

The CCITT currently defines at least eighteen PAD parameters. The values of these parameters represent specific characteristics that the DTE wants the PAD to adopt on receipt of data from the local terminal or the remote correspondent. Some of the parameters that can be set are:

1 Pad recall using a character
2 Echo on or off
3 Selection of data-forwarding signals
4 Selection of idle timer delay
5 Ancillary device control
6 Control of PAD service signals
7 Selecting operation of PAD on receipt of the break signal from the C-DTE
8 Discard output
9 Padding after carriage return
10 Line folding
11 Binary (line) speed of C-DTE
12 Flow control of the PAD by the C-DTE
13 Linefeed insertion after carriage return
14 Padding after linefeed
15 Editing
16 Character delete character
17 Line delete character
18 Line display character

A full explanation of these eighteen basic parameters is given in Telecom's Austpac packet switched data service asynchronous character mode service (X.28) user guide, pp. 16-29.

Standard PAD profiles

The values of the parameters can be chosen at the time of registration to suit the particular needs of the C-DTE, and there are quite a few to choose from for each parameter. Once they are chosen, a C-DTE has got what is called a standard PAD profile. Table 1 gives the parameters values in each standard profile.

The Computer Centre has chosen a local profile suitable for its current use; the DEU, for its second Austpac account, uses the simple profile which is known as profile zero. Profile no. 9 is used only for 1200/75 bps users who want to access a videotex system.

Table 1

	PROFILE NUMBER												
PAR REF.	0	1	2	3	4	5	6	7	8	9	10	11	12
1	1	0	0	1	1	1	1	1	1	1	1	0	1
2	1	0	0	0	0	0	1	1	1	0	1	0	0
3	126	0	0	2	2	126	126	2	2	2	2	0	126
4	0	20	10	80	40	200	0	0	0	0	40	3	0
5	1	0	1	0	0	1	1	1	1	0	0	0	1
6	1	0	0	1	1	1	1	1	1	1	1	0	1
7	2	2	21	21	21	21	21	8	21	0	21	21	2
8	0	0	0	0	0	0	0	0	0	0	0	0	0
9	0	0	0	0	4	7	0	4	7	0	4	0	0
10	0	0	0	0	0	0	0	0	72	69	0	0	0
11	Cannot be set: not predefined in any profile												
12	1	0	1	0	0	1	1	1	1	0	0	0	1
13	0	0	0	0	0	0	0	0	1	0	0	0	0
14	0	0	0	0	0	0	0	0	7	0	0	0	0
15	0	0	0	0	0	0	0	0	0	0	0	0	0
16	8	8	8	8	8	8	8	8	8	8	8	8	8
17	24	24	24	24	24	24	24	24	24	24	24	24	24
18	42	42	42	42	42	42	42	42	42	42	42	42	42

The values in the above table are explained in Appendix 1.

The DEU and the computing students have found their PAD standard profiles on Bravo quite suitable for most uses. Some slight adjustment is necessary for DEU staff, of course, when they change from the use of the Deakin profile to that of the simple profile, and because of this, the DEU will be modifying the latter in early 1986. However, we would recommend that users do not modify the PAD profile on their own without expert assistance.

Understanding the indications from PAD

During an Austpac session, a C-DTE user will see some signals or codes flashing across his screen. These are indications or signals from PAD that a user should try to understand. The indications appear as mnemonics followed sometimes by numerals, the latter being the diagnostic codes which in cases of operational difficulties should be reported together with the mnemonics to the Telecom maintainance staff on the toll-free number (1107 in all states except NSW, and 2110711 in NSW).

Table 2 is a list of indications from the PAD with explanations. The CLR prefix for the codes have no great significance.

Table 2

Signal	Explanation
CLR OCC	The correspondent is engaged in other calls and cannot accept the incoming call
CLR INV	Invalid facility requested by the calling DTE
CLR RNA	Called DTE does not subscribe to reverse charging
CLR NC or RESET	A network condition exists, e.g. temporary congestion or fault.
CLR NA	The calling DTE is not permitted to obtain the connection to the called DTE
CLR NP	The called DTE address is outside the numbering plan or is unassigned
CLR RPE or RESET RPE	A procedural error has been detected at the remote DTE - network interface
CLR ERR or RESET ERR	A procedural error caused by the local DTE is detected by the PAD, e.g. incorrect address format
CLR ID	The call is not compatible with the remote destination
CLR CONF	Response of PAD to valid clearing by the C-DTE
CLR PAD	The PAD has cleared the call at the invitation of the correspondent
RESET PAD	The PAD has reset the call

These signals, as mentioned earlier, are used together with numerals to give diagnostic codes, a partial list of which are provided in the Computer Centre's Computer users handbook, which are reproduced for this paper as Appendix 2. For the reference of people who would like more technical and fuller information, we have produced excerpts of Telecom literature on the PAD signals and codes as Appendix 3.

Obviously this paper cannot give guidance or what to do when a user receives a code signifying trouble or setback. So the best suggestion we can offer is to ask the user to make a note of the circumstances, the signals or diagnostic codes displayed and to get off the network quickly so as not to incur unnecessary connect-time charges. Disconnect the virtual call by pressing the control key and the P key together, then type CLR if one is using a central computer system with dedicated line access. PSTN access users can disconnect themselves by simply hanging up the telephone.

NUI and X.25 addresses

Deakin students given permission to access Bravo do not have to use an NUI because they are permitted to reverse their charges. They simply dial the Deakin Austpac national number (i.e. the network address) which is in fact the Austpac translation of the Deakin corporate NUI.

For an external user with no reverse charge privilege but who has his own Austpac NUI, he can key in the confidential NUI given to him after registering with Telecom. It is a 12-character alphanumeric sequence which does not echo onto the screen when he types it in. It looks something like the one below:

674571BCDEB9

After dialling one of the three Austpac telephone numbers (01921, 01922, 01923), and getting the 'AUSTPAC' indication, he will first type in a question mark, then put the caps lock on to type in an N, followed by his NUI, both of which are not echoed on the screen.

?N<NUI>

He will then have to type a hyphen and the correspondent's network address, both of which are visible. Lastly he will hit a carriage return to get the virtual call connection. So the complete input will be like this:

?N<NUI>-<ADDRESS> CR

All this typing can be a bit of bother. He can, however, get a programmer to write a script file for him to save him all the typing of numbers, password, etc. If he has a Macintosh, he can ask to be shown how to use the copy-and-paste technique to achieve similar results.

The network address for Deakin's Bravo is in two forms, depending partly on where the user is calling from.

252421000 (for calling within Australia)
0505252421000 (for calling from outside Australia)

In the shorter form (i.e. the national address), the first digit (i.e. 2) represents Austpac, while the remaining digits are the terminal identifier given by Telecom. The whole number is sometimes called the national number.

The longer form (i.e. the international address) must be used when people are calling from outside Australia. We will now separate the long address into blocks to explain the significance of each. We hope that this will be helpful to users who are given an incomplete address and do not know what to prefix it with in order to make a virtue call.

0 505 2 52421000

The first digit (0) is the international call prefix for Austpac.

505 is the country data code assigned to Australia by the CCITT.

2 is the network identifier for Austpac (3 for Midas)

52421000 is the eight-digit terminal identifier for Bravo given by Austpac.

252421000 is therefore called the national number.

5052 is sometimes referred to as the DNIC (Data Network Identification Code)

Let us look at the network address of the OU.

0 2342 90800103 20

The structure is similar to the Deakin one. The first zero is the international call prefix, the number 234 is the country data code assigned to the United Kingdom, and the 2 following is the network identifier for PSS (which is the UK equivalent of Austpac). The final two digits are the optional sub-address.

The addresses of the OU and Deakin P-DTE are often referred to as X.25 addresses because they observe the hardware interface protocol in CCITT Recommendation X.25 that lays down the rules necessary to establish a physical link between the DTE and the packet-switching network in their country. An X.25 address can choose to accept incoming calls either all the time or some of the time.

Table 3 gives the DNIC of packet switching networks around the world:

Table 3

Country	Network	DNIC
Australia	AUSTPAC	5052
	MIDAS	5053
Austria	RADIO - AUSTRIA	2329
	DATEX - P	2322
Belgium	DCS	2062
Canada	TELEGLOBE	3023
	DATAPAC	3020
	INFOSWITCH	3029
Finland	DATAPAK	2442
France	TRANSPAC	2080
	NTI	2081
Germany	DATEX - P	2624
Hong Kong	IDAS	4542
	DAS	4544
Japan	VENUS/P	4408
	DDX/P	4401
Luxembourg	LUXPAC	2704
New Zealand	PACNET	5301
Norway	NORPAK	2422
Singapore	TELEPAC	5252
South Africa	SAPONET	6550
Sweden	TELEPAK	2405
Switzerland	TELEPAC	2284
	DATALINK	2289
United Kingdom	IPSS	2341
	PSS	2342
USA	ITT	3103/3107
	WUI	3104
	TYMNET	3106
	TELENET	3110/3127
	RCA	3113
	TRT	3119
	UNINET	3125
	AUTONET	3126
	ALASKANET	3135

Variables in successful usage of Austpac

So far, we have dwelt rather heavily on the technical aspects of Austpac for some good reasons. We wish to emphasise that while Austpac is not difficult to use once the basic concepts are understood, some user training is necessary. One has to remember too that there are three computer systems and at least one human user involved in any access session, so difficulties can arise for a variety of reasons:

* The user has not understood the basic concepts of a packet-switching data service like Austpac and its PAD indications and codes.

* The user does not know enough about the local DTE.

* The user does not know enough about the remote DTE.

* There is some occasional problem with the Austpac network.

The user can spend time at his terminal to try to solve the problems on his own, if he wants do, but he may be inhibited from doing so by economic considerations. There are also some traffic problems, in our view, with Austpac which are difficult to identify or prove without full acknowledgement and cooperation of Telecom in monitoring them. We do believe that some training sessions with proper guidance and supervision are necessary in the beginning, and vigilant evaluation of the performance of Austpac is a must for serious users.

Problems encountered in the 1985 Austpac trials

The following are problems that the DEU has experienced in its six months of Austpac use:

1 Failing to get the PAD on Bravo

The DEU has a constant problem of getting the PAD on Bravo and when this happens, it has to request the Computer Centre to reset it to make the connection to the OU. The cause is yet to be discovered.

2 Network congestion

The signal CLR NC flashes frequently in morning sessions and after 3 pm through till midnight. When traffic is heavy in the network, a character keyed in on the keyboard can take as long as 15 seconds to echo onto the screen.

We suggest that the following may be the reasons:

* Most people prefer accessing Austpac in early mornings and late afternoons.

* Organisations exploit the after-hour discount effective after 6 pm for traffic volume (50%) and for connect time charges which is applicable for dedicated access (90%).

3 Low transmission rate

Access via PSTN using 300/300 or 1200/75 bps or Bravo via a 2400/2400 bps dedicated line have not been yielding impressive transmission rates on an average. We have had instances of getting only 90 bps while using a 300/300 speed.

4 Technical problems and service failure

Three sessions conducted one Thursday afternoon, later that night and the morning after in late October 1985 were horrendously difficult. The time taken for a sent character to echo on the local C-DTE was as high as 25 seconds. The line dropped at one point and caused a very long file to stop sending in the last few packets. Some commands would not work either. A complaint to the technical hot line (1107) the following Monday was not satisfactorily dealt with. But later close reading of some of the Austpac literature issued by Telecom revealed that routine maintenance of the service occurs between Thursday 11 p.m. and Friday 7 p.m. (Melbourne time). The literature also admits that service could be interupted, but it reassures the user that:

> Discounting this activity, virtual circuit failure rates will be no worse than one failure per fifty hours of use.
>
> ...Present failure rates and mean time to repair (MTTR) performance indicate customer access availability better than 99%.
>
> (Telecom Austpac facilities February 1985, p.10).

The DEU has now been given two other telephone numbers by Telecom and the OTC to request help with transmission problems, but late week access continues to be problematic.

Putting computer-mediated communications to educational use

DEU's interest in information technology stemmed from a belief that it could help:

* Assist the course development process by facilitating an electronic community of scholars;

* Reduce the isolation of distance students and bring some other additional benefits.

But equally it believes that this can come about only if the right conditions have been put in place to make the use of technologies pleasant and relatively easy.

Computer scientists have been using electronic means to communicate with one another for many years, but this practice has only started to attract the attention of people in the field of mainstream and distance education in the last couple of years. Electronic communication using hardware and software which are incompatible, however, is a specialised field that not many non-communication experts can understand or handle, and so the use of technology cannot be said to be pleasant and easy yet for the lay person.

Still, there is no reason why systematic investigation into the potentials of information technology for the use of distance education should not be undertaken at Deakin. Psychologists at Carnegie-Mellon University are conducting a major socio-psychological study of information technology, and some of the published papers have already thrown fascinating insights on how technology have affected the behaviour of staff and students.

The research project at the DEU (code name MEDD) is a small-scale project to see how a group of distance educators use computer-mediated communications and to evaluate their personal and professional responses to technology. The DEU hypothesis is that, computer-mediated communications, if properly introduced and carefully implemented, is not only feasible but desirable as adjuncts to conventional course development process and learning support for some postgraduate programs with a relatively small student population. For example, course writers can use the network (an alternative structure to the conventional course team which meets face-to-face) to communicate with all or a particular colleague and can consult research databases which reside within or outside that network. If the findings are encouraging, then may be it will be feasible to translate such a small network into a more extensive network for student support. Some of the things that a student can do then will be: using a computer to communicate with their teaching institutions and fellow students for a wider range of activities than just submitting assignments, consult a library catalogue and order or return books, and search bibliographic or information databases directly without going through an intermediary. This means that Deakin will be able to live up to its promise of being an open campus university at last.

Packet-switching network services seem to be the best public and probably the only current option for making all such activities possible. Packet-switching services are really not too expensive if one keeps in perspective the benefits they can bring. In a packet-switching network like Austpac or Midas, the packets belonging to different users share the resources in the switching nodes and the interconnecting trunks (see Figure 1). This reduces the cost to each user when compared to the cost of establishing a private leased

network which is probably beyond the means of most institutions anyway.

Staff and student development in the use of computer technology

In this paper, we mention the assistance given by Deakin's Computer Centre to computing students and staff. In 1986 and the next few years, there will be more and more staff and other non-computing students wanting to use Austpac, microcomputers, and the central computers as they discover what technology can do for them. There will also be the implementation of a Local Area Network in 1987 which will allow more optimal exploitation of Deakin's total computingg facilities. These are indeed exciting opportunities to look forward to. But making all these opportunities available is perhaps not quite enough; intending and current users need help as well. The Computer Centre has therefore taken a number of initiatives in this direction by:

* Providing a consultant programmer to all staff and students;
* Providing a Personal Computing Counsellor; and
* Mounting training sessions.

We are hopeful that Deakin will strive to do more when resources permit. But Deakin, like educational institutions around the world, is caught in the chicken-and-egg situation of having to decide whether to pour the limited funds into the purchase of better hardware and software, appoint more computing staff to cope with increasing day-to-day workload, or take the development and training role more seriously than it is already doing now. But there is perhaps more urgency in Deakin's case because of its large number of off-campus enrolment and its very active off-campus program. Staff and students engaged in distance teaching and learning will need some help to exploit technologies. The mastery of Austpac is perhaps a useful first step in that direction. We hope, therefore, that this paper has been helpful in unravelling some of the mystery of packet-switching networks for the use of distance education.

About the authors

Angela Castro is an instructional designer in a research and development division within Deakin University. Lee Stirzaker is a senior analyst and network specialist. Angela and Lee are respectively the Chairman and Database Manager of AOLIN (Australian Open Learning Information Network), a national network for information technology researchers. They can be reached through a number of electronic addresses on ACSNET, UUCP, ARPA, Viatel, etc. For Dialcom systems users, their Minerva address is 07:DEE001.

Appendix 1

Values of PAD parameters

(Source: Telecom Australia, 1983.)

Parameter Reference Number	Parameter Description	Selectable Values Optional	PAD Parameter Meaning
1	PAD recall using a character	0	Not possible
		1	Character DLE
		32-126	Possible; using one graphic character defined by user
2	Echo	0	No Echo
		1	Echo
3	Selection of data forwarding signal	0	No data forwarding signal
		2	Character CR
		126	All characters in columns 0 & 1 and character DEL
		6	Characters CR, ESC, BEL, ENQ, ACK
		18	Characters CR, EOT
4	Selection of idle timer delay	0	No idle timer delay
		1-255	Value of idle timer delay in twentieths of a second
5	Ancillary device control Control of C-DTE by PAD	0	No use of X-ON (DC1) X-OFF (DC3)
		1	Use of X-ON and X-OFF
6	Control of PAD Indications	0	No PAD service signals are transmitted to the C-DTE
		1	PAD service signals are transmitted
		5	PAD service signals and the prompt PAD service signal are transmitted
7	Selection of operation of PAD on receipt of break signal from the start-stop DTE	0	Nothing
		1	Interrupt
		2	Reset
		8	Escape from data transfer state
		21	Discard output, interrupt and indication of break
8	Discard output	1	Discard output
		0	Normal data delivery
9	Padding after carriage return	0	No padding after CR
		1-7	Characters inserted after CR
10	Line folding	0	No line folding
		1-255	Number of characters per line
11	Binary speed of start-stop DTE	0	110 bit/s
		1	134.5 bit/s
		2	300 bit/s
		3	1200 bit/s
		4	600 bit/s
		5	75 bit/s
		6	150 bit/s
		7	1800 bit/s
		8	200 bit/s
		9	100 bit/s
		10	50 bit/s
		11	75/1200 bit/s
		12	2400 bit/s
		13	4800 bit/s
		14	9600 bit/s
		15	19200 bit/s
		16	48000 bit/s
12	Flow control of the PAD	0	No use of X-ON (DC1) and X-OFF (DC3)
		1	Use of X-ON (DC1) and X-OFF (DC3)
13	Linefeed insertion after carriage return	0	No linefeed
		1	Insert linefeed after trans. of CR
		4	Insert linefeed after echo of CR to start-stop mode DTE
		5	Insert linefeed after transmission to the start-stop
		6	Insert linefeed in data after CR from start-stop mode DTE and after echo of a CR to the start-stop mode DTE
		7	Insert linefeed in the data stream to and from the start-stop DTE and after echo of CR to the start-stop mode DTE
14	Padding after linefeed	0	No padding after linefeed
		1-7	Number of padding characters inserted after linefeed
15	Editing	0	No use of editing in the data transfer state
		1	Use of editing
16	Character delete	0, 1-127	One character from range of IA5
17	Line delete	0, 1-127	One character from range of IA5 Character 1/8 (CAN)

Appendix 2

Guidance for computing students using Austpac access to Bravo

(Source: Computer Centre computer users handbook, Deakin University, 1985, pp.17-18.)

If the connection is unsuccessful a diagnostic message will be printed in the form

signal mnemonic diagnostic code

The signal, mnemonic and diagnostic codes are described in the table below.

Signal	Definition
com	Call connected
clr conf	Clear confirmation
clr occ (dc)	Called DTE busy
clr nc (dc)	Network congestion
clr inv (dc)	Invalid call
clr na (dc)	Access barred
clr err (dc)	Local procedure error
clr rpe (dc)	Clear indication
clr np (dc)	Not obtainable
clr der (dc)	Out of order called DTE
clr pad (dc)	Clear indication
clr dte (dc)	Clear indication
reset dte (dc)	Reset
reset err (dc)	Reset
reset nc (dc)	Reset
err	Error
engaged	Call status
free	Call status

Clear Cause Diagnostic Code

Code	Mnemonic	Meaning
0	dte	The remote X.25 DTE has cleared the call
1	occ	Number Busy
3	inv	Invalid Facility Request
5	nc	Network Congestion
9	der	Out-of-Order
11	na	Access Barred
13	np	Not Obtainable
17	rpe	Remote Procedure Error
19	err	Local Procedure Error
21	pad	Local PAD received an Invitation to clear
25	nrc	Reverse Charging Acceptance Not Subscribed
33	inc	Incompatible Destination
41	nfs	Fast-Select Acceptance Not Subscribed
128		Channel is Busied-Out
129		Device Not Ready
130		Channel Can Place Outgoing Calls Only
131		Device in X.28 Command Mode
132		Device Being Disconnected
133		Invalid Access Right
134		Channel Not Available
135		Channel Received a Restart
136		Link Not Up
137		Remote DTE address does not exist
138		No SVCs available

Reset Cause Diagnostic Code

Code	Mnemonic	Meaning
0	dte	DTE Originated
1	der	Out-of-Order (PVC Use Only)
3	rpe	Remote Procedure Error
5	err	Local Procedure Error
7	nc	Network Congestion
9	rop	Remote DTE Operational (PVC Use Only)
15	nop	Network Operational (PVC Use Only)
17	inc	Incompatible Destination
128		Channel Received a Restart
129		Remote Device Not Ready
130		Line Down
131		Remote PVC out of order

If you get the response

ERR

you have typed the command incorrectly.

Appendix 3 PAD indications and codes

(Source: Telecom Australia, 1983.)

PAD INDICATIONS

INDICATION FORMAT	EXPLANATION
RESET [cause] DTE / ERR / NO	Reset of call/circuit
COM	Call connected
COM	There is an incoming call
CLR [cause]	Call/circuit cleared
AUSTPAC identifier	Link active
ERROR	Error in PAD command

Indications associated with incoming events

XXX	Line delete function completed. (Line delete char echoed if P2 = 1)
ENGAGED	Response to 'STATUS' PAD command when call established
FREE	Response when call not established (see ENGAGED)
PAR	Response to PAD commands (Par? or Set?)
FORMAT EFFECTOR CR/LF	Acknowledge PAD service signal
RESET PAD	PAD caused reset of virtual call

CLEARING CAUSES AND INDICATIONS

CLEARING CAUSE	INDICATION
DTE originated	CLR DTE
Number busy	CLR OCC
Invalid call	CLR INV
Network congestion (or "incident")	CLR NC
Out of order	CLR OER
Access barred	CLR NA
Not obtainable	CLR NP
Remote procedure error	CLR RPE
Local procedure error	CLR ERR
Reverse charging acceptance not subscribed	CLR INV
Response of PAD to an INVITATION TO CLEAR PAD message	CLR PAD
Response of PAD to clearing by the C-DTE	CLR CONF or CLR ERR

RESET CAUSES AND INDICATIONS

CAUSE OF RESET	INDICATION
DTE originated	RESET DTE
Local procedure error	RESET ERR
Network congestion	RESET NC
PAD reset	RESET PAD

CAUSE AND DIAGNOSTIC CODES

REF: APPENDIX 2 SPEC 6

CODING OF CLEARING CAUSE FIELD IN CLEAR INDICATION PACKET

CLEARING CAUSE	HEXADECIMAL CODING
DTE Clearing	00
Number busy	01
Out of Order	09
Remote Procedure Error	11
Invalid Facility Request	03
Access Barred	0B
Local Procedure Error	13
Network Congestion	05
Not Obtainable	09
Reverse Charging Acceptance Not Subscribed	19

CODING OF RESETTING CAUSE FIELD IN RESET INDICATION PACKET

RESETTING CAUSE	HEXADECIMAL CODING
DTE Reset	00
Out of Order (PVC only)	01
Remote Procedure Error	03
Local Procedure Error	05
Network Congestion	07
Remote DTE Operational (PVC only)	09
Network Operational (PVC only)	0F

CODING OF RESTARTING CAUSE FIELD IN RESTART INDICATION PACKETS

RESTARTING CAUSE	HEXADECIMAL CODING
Local Procedure Error	01
Network Congestion	03
Network Operational	07

DIAGNOSTIC CODE: DECIMAL	HEX	P (DTE)	C (DTE)	DIAGNOSTIC	PACKET TYPES
Any 225		•	•	Restart & Reset or clearing by remote DTE	CLR RSET
1		•	•	Invalid P(S)	RSET
2	2	•	•	Invalid P(R)	RSET
16	10	•	X	Error during restart phase	RSTA
18	12	•	•	Error during reset phase	RSET
33	21	•	•	Unassigned packet (PVC only)	RSET RSTA
34	22	•	•	Call on one-way logical channel	CLR
38	26	•	•	Packet on unassigned logical channel	CLR
37	25	•	X	REJECT not subscribed to	RSET
39	27	•	•	Packet too long or too short	RSET
41	29	•	•	Restart with non-zero in bits 1-4, 9-16	RSTA CLR RSET
48	21	•	•	Timer expired for INCOMING CALL	CLR
51	33	•	•	Timer expired for RESET INDICATION	CLR
65	41	•	•	Facility code not allowed	CLR
66	42	•	•	Facility parameter not allowed	CLR
80	50	•	•	Error during call set up or clearing phase	CLR
128	80				CLR
129	81	•	•	Internal Network Event	CLR RSET
145	91				
146	92	•	X	Remote disconnection	RSET
147	93	•	X	Remote connection	RSET
148	94	•	X	DTE disconnection	RSET
149	95	•	X	Disconnection call / rejected, gid, global error	RSET
150	96	•	X	Disconnection (by network	RSET
160	A0	•	•	ABE connection	CLR
161	A1	•	•	ABE connection	CLR
162	A2	•	•	ABE, out of service (by network command)	CLR
163	A3	•	•	Incorrect Clock	CLR
164	A4	•	•	Unknown requested service	CLR
165	A5	•	•	Error in traffic generator command	RSET
166	A6	•	•	Loss of resource	RSET
167	A7	•	•	Execution of a command by traffic generator	RSET
168	A8	•	•	Flow control blocked on DTE, local congestion	RSET
169	A9	X	•	Invalid P(S)	RSET
170	AA	X	•	Retransmit P(S)	RSET
171	AB	•	•	Incorrect call request packet length	CLR
172	AC	•	•	Clock unsynchron	RSET
173	AD	•	•	Loss of virtual connections	RSET
174	AE	•	•	Reset Q bit in the same connect packet sequence	RSET
175	AF	•	•	PAD message (PAD only)	RSET
176	B0	•	•	Errors of remote C-DTE	RSET
177	B1	•	•	Reset command by remote C-DTE	RSET
178	B2	•	•	Clearing by LCP	CLR
179	B3	•	•	Clearing by command of service DTE	CLR
180	B4	•	•	Response of PAD to an invitation to Clear PAD service from the service A-DTE	CLR
181	B5	•	•	Synchronized loss of virtual circuits	CLR
182	B6	•	•	Error during restart phase	CLR
183	B7	•	•	Error during restart phase	CLR

• Received
X Emmitted
} for type of DTE